

## **6.4 COMPARATIVE ANALYSIS**

The alternatives were evaluated and compared against the seven cleanup criteria identified in § 75-10-721, MCA. Protectiveness and compliance with ERCLs are threshold criteria that must be met for any remedy. In the comparative analysis, the remaining criteria are weighed and evaluated to identify the best overall alternatives for each media. Each criterion is listed individually below.

### **6.4.1 Protection of public health, safety, and welfare and of the environment (Protectiveness):**

Alternative 1, 2, and 3 would not provide adequate protection of public health, safety, and welfare and the environment in the short-term or long-term because people would continue to be exposed to unacceptable levels of contamination in the soil and contaminants would continue to leach to groundwater. However, alternatives 2 and 3, if combined with soil and groundwater alternatives, may provide adequate protection in the long-term. Alternatives 4 through 9 cannot provide adequate protection in the short-term and long-term unless they are combined with other alternatives to address the risks posed by all of the contaminated media at the KRY Site. For instance, alternatives 2 or 3 could be combined with alternatives 5 or 6 to be protective. It may also be possible to combine alternatives 2 or 3 with some combination of alternatives 4, 7, 8, and 9 to ensure protectiveness. Institutional controls would be necessary for short-term and long-term protectiveness no matter what alternatives are selected. Alternatives 1, 7, and 10 as stand alone options would not provide adequate protection for over 100 years. Alternatives 2, 3, 8, and 9 as stand alone options would likely not provide adequate protection for 40 to 100 years. Alternatives 4, 5, and 6 would likely not provide adequate protection for 10 years. However, the timeframe could be drastically reduced for some of these alternatives, specifically 2, 3, 8, and 9, if used in conjunction with other alternatives.

### **6.4.2 Compliance with ERCLs**

Alternative 1 is not expected to reach groundwater cleanup levels for more than 100 years. However, when compared to other alternatives this is not a reasonable timeframe. Free product would also remain. Therefore, alternative does not meet ERCLs. Alternatives 2 through 9 will

comply with ERCLs when combined with other alternatives. Any combination of alternatives that would remove free-product to the maximum extent practicable, reduce groundwater concentrations to levels that meet Montana water quality standards, and treats PCP-contaminated soils that are banned from land disposal to site-specific cleanup levels, including leaching to groundwater numbers would comply with ERCLs. Alternatives 1, 7, and 10 as stand alone options would not meet ERCLs for over 100 years. Alternatives 2, 3, 8, and 9 as stand alone options would likely not meet ERCLs for 40 to 100 years. Alternatives 4, 5, and 6 would likely not meet ERCLs for 10 years. However, the timeframe could be drastically reduced for some of these alternatives, specifically 2, 3, 8, and 9, if used in conjunction with other alternatives.

### **6.4.3 Mitigation of Risk**

Under Alternative 1, free-product, sludge in soil and contaminated soils and groundwater would remain at the KRY Site. Unacceptable risk would exist and would not be mitigated by this alternative. Alternatives 2 and 3 do not mitigate risk because residual sludge, soil, and groundwater contamination would remain. Some mitigation of risk would occur as a result of removing free-product that continues to release contaminants to groundwater. Alternative 4 mitigates some risks posed by groundwater contamination because it treats contaminated groundwater. However, it does not mitigate risk associated with sludge, free-product in the groundwater, or soil contamination. Alternative 5 mitigates some risks because it treats PCP and petroleum contamination in soil and groundwater. However, it is unlikely that this alternative would be effective at treating free-product, sludge, dioxins/furans or metals and therefore would not mitigate risk associated with those compounds. Alternative 6 mitigates some risks because it treats PCP, petroleum and may treat dioxins/furans. It would not effectively treat free-product, sludge or metals. Alternative 7 mitigates some direct exposure to contaminated soils but contamination would remain in soil and fluctuating groundwater would continue to mobilize contaminants from soil and free-product. Institutional controls and long-term maintenance would be needed to ensure the integrity of the barrier and prevent direct contact with contamination. Alternative 8 would mitigate risk posed by contaminated soils because they would be excavated and removed from the KRY Site. However, free-product and contaminated groundwater would remain and people may be exposed to contaminants. Alternative 9 would mitigate some risk because all contaminants in the soil would be removed and treated. However,

it is uncertain if this alternative will reduce dioxin/furan concentrations to acceptable levels. Free-product and contaminated groundwater would also remain and people may be exposed to contaminants. Unacceptable risk would exist and would not be mitigated under Alternative 10, as free-product, sludge, and contaminated soils and groundwater are not addressed. Alternatives 2 through 10 have the potential to mitigate risks when combined with other alternatives in the right combinations.

#### **6.4.4 Effectiveness and Reliability in the Short-Term and Long-Term**

Alternative 1 is not effective and reliable in the short-term and long-term because unacceptable levels of contamination would remain and contaminants would continue to be released to the environment. Alternative 2 and 3 are effective and reliable for removing free-product but other alternatives would be needed to address residual soil and groundwater contamination.

Alternative 4 would be effective on some contaminants at the KRY Site, but is not expected to be effective on dioxins/furans or metals. Additional treatment would likely be required. A pilot study would be necessary to better evaluate the effectiveness of this alternative. Alternative 5 would be effective for PCP and petroleum, but is not expected to be effective for treating dioxins/furans or metals. Pilot testing would be needed to define reaction rates and identify enhancements that would be needed to improve efficiency. Site-specific tests demonstrate that ozonation, which could be a component of Alternative 6, is effective at treating dissolved petroleum, PCP and dioxins/furans. However, it is unlikely to be effective on metals contamination or free-product. It is also uncertain if this alternative would achieve dioxin/furan cleanup levels in soils. Pilot testing would be needed to determine the effectiveness of this alternative on soils at the KRY Site. Alternative 7 is somewhat effective at preventing people from directly contacting contaminated soils. Barriers are susceptible to weathering and may crack, reducing the effectiveness of the barrier in the long-term. Maintenance of the barrier in perpetuity would be required. Because contaminated soil would remain and fluctuating groundwater would continue to mobilize contaminants, this alternative is not effective on its own for free-product and site wide groundwater contamination. Alternative 8 is effective in the short-term and long-term at removing contaminated soil up to 30 feet below ground surface. Because contaminated soil would be disposed of at a licensed engineered offsite facility, regulatory requirements for the offsite facility would effectively control contaminants in the long-term. This alternative by itself is not effective for treating free-product or groundwater contamination. Alternative 9 is effective in the short-term and long-term at removing contaminated soil up to 30

feet below ground surface. Subsequent ex-situ treatment would reduce the toxicity and volume of some contaminants in the soil. The effectiveness of ex-situ treatment at reducing dioxin/furan concentrations to acceptable levels is uncertain. This alternative by itself is not effective for treating free-product or groundwater contamination. Alternative 10 is not effective and reliable in the short-term and long-term because unacceptable levels of contamination would remain and continue to be released to the environment.

#### **6.4.5 Technically Practicable and Implementable**

All the alternatives are technically practicable and implementable at the KRY Site.

#### **6.4.6 Treatment Technologies or Resource Recovery Technologies (Giving due consideration to engineering controls)**

Alternatives 1, 7, and 8 do not use treatment or resource recovery technologies. The remaining alternatives include some form of treatment or resource recovery technology. Any alternative that requires onsite treatment will likely require fencing of portions of the KRY Site to ensure protection of human health in the short-term.

#### **6.4.7 Cost Effectiveness**

Alternatives 1 through 4 are less costly than the other alternatives (see Table 6-2 and Appendix F). However, alternatives 1 through 4 by themselves do not sufficiently reduce risks associated with contaminated soils.

Alternative 5 or Alternative 6 combined with either free-product recovery alternative (2 and 3) provides substantial risk reduction and requires less long-term care than Alternative 7.

Alternatives 5 and 6 are less expensive than Alternative 8 but require more care and provide less risk reduction.

Alternative 7 provides for risk reduction by preventing direct contact with contaminated soils. However, it does not reduce risk associated with free-product or contaminated groundwater. Long-term costs associated with Alternative 7 are included in the estimated cost. Aside from Alternatives 1 and 10, Alternative 7 is the least expensive alternative. However, with the exception of Alternatives 1 and 10, Alternative 7 also provides the least amount of risk reduction.

Alternative 8 combined with Alternative 4, or the groundwater component of Alternatives 5 or 6, and either free-product recovery alternative (2 and 3) provides greater risk reduction than other alternatives, but any of these alternatives combined with Alternative 8 are the most costly.

Alternative 9 combined with Alternative 4, or the groundwater component of Alternatives 5 or 6, and either free-product recovery alternative (2 and 3) provides substantial risk reduction and requires less long-term care than Alternative 7.

Alternative 10 is less costly than other alternatives, but does not reduce risks associated with contaminated soils, sludge, free-product on groundwater, or groundwater (as long as contaminant concentrations exceed cleanup levels). Alternative 10 combined with any combination of alternatives that removed source materials in soil and groundwater provides some risk reduction at a negligible increase in cost over the cost associated with the other alternatives.